MICROSILICA MODIFIED CONCRETE OVERLAY
November 27, 1995

General Requirements

1.01 Description

A. The Contractor shall furnish material for and install the concrete overlay as shown in the Plans. The concrete shall be produced and installed in accordance with this Special Provision.

1.02 Quality Assurance

A. The Engineer will perform slump and entrained air tests after the Contractor has approved the concrete for placement. No concrete shall be placed until these tests are completed and the Engineer has approved the concrete for placement. The tests will be performed on each of the first two concrete loads for each day of placement. If a load is rejected, an additional load will be tested. After discharging 4 to 5 cubic feet of concrete , the sample to be tested shall be discharged into a wheelbarrow (approximately 4 cubic feet). Slump and entrained air testing will then be performed in accordance with WSDOT Test Methods 804 and 805 respectively. The 4 to 5 cubic feet of concrete initially discharged may be placed providing the material has not been contaminated and the concrete load has been approved by the Engineer for placement.

B. Operational control tests for slump and entrained air for concrete will be conducted on randomly selected samples in conformance with the following schedules:

Daily Production (cubic yards)	Frequency of Sampling and testing
over 8	1 every 15 cu. yds.

Samples shall be randomly selected in accordance with WSDOT test method 803. Concrete shall be sampled as follows:

1. After one third of the load has been placed, the stream of concrete shall be diverted into a wheelbarrow. Approximately 1 cubic foot of concrete will be needed to perform a slump and air test.

2. Take samples to the test site. The test site should be located away from the placement operation and off of the bridge deck if practical.

Protect the concrete from exposure to wind and direct sunlight while performing the tests. Perform the slump and entrained air test in accordance with WSDOT test methods 804 and 805 respectively.

The Engineer will test for slump and/or air any load of concrete he deems necessary. Concrete specimens for compressive strength and permeability tests shall be made as directed by the Engineer.

1.03 Submittals

A. The Contractor shall submit the proposed mix design for review prior to the date of overlay placement. The mix design shall be in accordance with Section 2.02, Proportioning Materials, of this Special Provision.

1.04 Storing And Handling

A. Storing and handling materials shall be in accordance with the Standard Specifications and the following:

1. Aggregate
Aggregates shall be stored and handled in such a manner as to prevent variations of more than 1.0 percent in moisture content of the stockpile.

2. High Molecular Weight Methacrylate Resin (HMWM)
The HMWM shall be stored in a cool dry place and protected from freezing and exposure to temperature in excess of 100 F. The promoter and initiator, if supplied separate from the resin, shall not contact each other directly. Containers of promoters and initiators shall not be stored together in a manner that will allow leakage or spillage from one to contact the containers or materials of the other.

Material Specifications

2.01 General

A. All material shall meet the requirements of Sections 9-01 and 9-03 and the following:

1. Portland Cement
Type III cement is not permitted.

2. Coarse Aggregate
Coarse aggregate shall meet the requirements of Section 9-03.1(3) Grading No. 6.

3. Fine Aggregate
Fine aggregate shall meet the requirements of Section 9-03.1(2) Class 1.

4. Sand For Abrasive Finish
Sand for abrasive finish shall be crushed sand, oven dried, and stored in moisture proof bags. The sand shall meet the following gradation requirements:

Sieve Size	Percent Passing	
	Min.	Max.
U.S. No. 8	100	
U.S. No. 30	97	100

All percentages are by weight.

5. Microsilica Admixture

The microsilica admixture shall be a dry powder or a slurry admixture and shall meet the requirements of AASHTO M 307.

Acceptance of microsilica will be based on a Manufacturer's Certificate of Compliance. If the microsilica is provided as a slurry, the microsilica content of the slurry shall be certified as a percent by weight.

6. High Molecular Weight Methacrylate Resin (HMWM)
The HMWM resin for crack and joint sealing shall conform to the following:

Viscosity	>	25 cps (Brookfield RVT w/ UL adaptor, 50 RPM at 77 F)... CA. Test 434
Density		8.5 to 8.8 lb/gal at 77 F... ASTM D 2849
Flash Point	>	200 F PMCC (Pinsky-Martens CC)
Vapor Pressure	<	1.0 mm Hg at 77 F ASTM D 323
Tg (DSC)	>	58 C ASTM D 3418
Gel. Time		60 Minutes Minimum

The promoter/initiator system for the methacrylate resin shall consist of a metal dryer and peroxide.

2.02 Proportioning Materials

A. The concrete shall be a workable mix, uniform in composition and consistency. Mix proportions per cubic yard shall be:

Portland cement	658	pounds
Microsilica Fume	52	pounds
Fine aggregate	1540	pounds
Coarse aggregate	1540	pounds
Air	6%±1 1/2%	
Maximum water/cement ratio	0.33	max.

B. The maximum water/cement ratio shall be calculated using all of the available mix water, including the free water in both the coarse and fine aggregate and in the microsilica slurry if a slurry is used.

C. The concrete shall have a maximum slump of 7 inches. The Contractor is responsible for adjusting the slump to accommodate the gradient of the deck.

D. Water reducing admixtures, air entraining admixtures, and superplasticizers shall be added as recommended by the supplier of the microsilica admixture.

Equipment

3.01 Rotary Mill

A. Rotary milling machines shall be capable of scarifying a minimum width of 4 feet per pass. Machines known to have the minimum specified capacity are the CMI Roto-Mill PR-225, the Gomaco Scaraplane, and the Barber Green RX-40.

B. Rotary milling machines shall conform to the provisions of Section 1-07.7. The Contractor shall submit to the Engineer the axle loads and spacings of the machine to be used at least 15 working days prior to the beginning of scarifying. Scarifying shall not begin until the Contractor has received written approval of the machine to be used from the Engineer.

3.02 Hydro Demolisher

A. Hydro demolishing machines shall be capable of scarifying a minimum width of 4 feet per pass. Scarifying shall not begin until the Contractor has received written approval of the machine to be used from the Engineer.

1. All water used in the hydro demolisher scarifying process shall be potable. Stream or lake water will not be permitted.

2. All bridge drains and other outlets within 100 feet of the hydro demolishing machine shall be temporarily plugged during the scarifying operation. The Contractor shall furnish the Engineer a plan outlining the methods by which excess runoff water and contaminates will be controlled.

3.03 Air Compressor

A. Air compressors shall be equipped with oil traps in order to eliminate oil from being blown onto the roadway deck during sandblasting and air-cleaning.

3.04 Vacuum Machine

A. Vacuum machines shall be capable of collecting all dust, concrete chips, free standing water and other debris encountered while cleaning during deck preparation. The machines shall be equipped with collection systems that will allow the machines to be operated in air pollution sensitive areas and shall be equipped so as not to contaminate the deck during final preparation for concrete placement.

3.05 Water Spraying System

A. The water spraying system shall include a portable high pressure sprayer with a separate water supply. The sprayer must be readily available to all parts of the deck being overlaid and must be able to discharge water in a fine mist to prevent accumulation of free water on the deck. Sufficient water must be available to thoroughly soak the deck being overlaid and to keep the deck wet prior to concrete placement.

B. The Contractor shall certify that the water spraying system meets the following requirements:

Pressure	2200	psi	minimum
Flow Rate	4.5	gpm	minimum
Fan Tip	15° to 25° Range		

3.06 Ready-Mix Truck

A. Ready mix trucks shall meet the requirements of Section 6-02.3(4)A.

3.07 Finishing Machine

A. The finishing machine shall meet the requirements of Section 6-02.3(10) and the following requirements:

1. The finishing machine shall be self-propelled and be capable of forward and reverse movement under positive control. Provisions shall be made for the raising and lowering of all screeds under positive control. The upper vertical limit of screed travel shall permit the screed to clear the finished concrete surface.

2. The finishing machine shall have the necessary adjustments to produce the required cross-section, line, and grade. When placing concrete in a lane or strip abutting a previously placed lane or strip, the side of the finishing machine adjacent to the completed lane or strip shall be equipped to travel on the completed lane or strip.

3. The finishing machine shall be equipped with a rotating cylindrical double drum screed not exceeding 60 inches in length preceeded by a vibrating pan. The vibrating pan shall be constructed of metal and be of sufficient length and width so as to properly consolidate the mixture. The vibrating frequency of the vibrating pan shall be variable with positive control between 3,000 and 6,000 rpm. A machine with a vibrating pan as an integral part may be proposed and will be considered for approval by the Engineer. Other finishing machines will be allowed subject to approval of the Engineer.

Construction Requirements

4.01 Deck Preparation

A. The entire roadway surface of the deck shall be scarified to remove the surface matrix of the concrete. Power operated rotary milling machines or hydro demolishing machines shall be used. Areas that are inaccessible to these machines shall be hand-chipped to the same depth.

The Contractor shall not scarify the roadway surface of the deck unless completion of the overlay can be accomplished within the current construction season.

All reinforcing steel damaged due to the Contractor's operations shall be repaired by the Contractor. For bridge decks existing prior to this Contract, damage to existing reinforcing steel shall be repaired and paid for in accordance with Section 1-09.6 if the existing concrete cover is 1/2 inch or less. All other reinforcing steel damaged due to the Contractor's operations shall be repaired by the Contractor at no cost to the State. The repair shall be as follows or as directed by the Engineer.

1. Damage to epoxy coating shall be repaired in accordance with Section 6-02.3(24)H.

2. Damage to bars resulting in a section loss of 20 percent or more of the bar area shall be repaired by chipping out the adjacent concrete and splicing a new bar of the same size. Concrete shall be removed to provide a 3/4 inch minimum clearance around the bars. The splice bars shall extend a minimum of 2 feet 6 inches beyond each end of the damage. Patching concrete shall be placed in accordance with Section 3.03 of the Special Provisions titled **FURTHER DECK PREPARATION**.

3. Any bars partially or completely removed from the deck shall have the damaged portions removed and spliced with new bars as outlined in Item 2 above.

B. After scarifying is completed, the lane or strip being overlaid shall be thoroughly cleaned of all dust, free standing water and loose particles. Cleaning may be accomplished by using compressed air, waterblasting, with a minimum pressure of 5,000 psi, or vacuum machines. Vacuum cleaning shall be used when required by applicable air pollution ordinances.

C. Once the lane or strip being overlaid has been cleaned of debris from scarifying, the Contractor under the direction of the Engineer, shall perform an inspection and shall mark those areas that require further deck preparation by the Contractor. Further deck preparation will be required when any one of the following conditions is present:

1. Unsound concrete.

2. Lack of bond between existing concrete and reinforcing steel.

3. Exposure of reinforcing steel to a depth of one-half of the periphery of a bar for a distance of 12 inches or more along the bar.

4. Existing non-concrete patches as marked by the Engineer.

D. If further deck preparation is necessary, it shall be done in accordance with the Special Provision **FURTHER DECK PREPARATION**. If the overlay is placed on a bridge deck constructed as part of this project, then all work associated with **FURTHER DECK PREPARATION** shall be at the Contractor's expense.

E. The entire lane or strip being overlaid shall then be sandblasted or shotblasted, using equipment approved by the Engineer, until sound concrete is exposed. Care shall be taken to ensure that all exposed reinforcing steel and the surrounding concrete is completely blasted. Bridge grate inlets, expansion dams and barriers above the surface to be blasted shall be protected from the blasting.

F. The final surface of the deck shall be free from oil and grease, rust and other foreign material that may reduce the bond of the new concrete to the old. These materials shall be removed by detergent- cleaning or other method as approved by the Engineer followed by sandblasting.

G. After all scarifying, chipping, sandblasting and cleaning is completed, the entire lane or strip being overlaid shall be cleaned in final preparation for placing concrete using either compressed air or vacuum machines. Vacuum machines shall be used when warranted by applicable air pollution ordinances.

H. Scarifying with rotary milling machines, chipping, sandblasting and cleaning in areas adjacent to a lane or strip being cleaned in final preparation for placing concrete shall be discontinued when final preparation is begun. Scarifying and chipping shall remain suspended until the concrete has been placed and the requirement for curing time has been satisfied. Sandblasting and cleaning shall remain suspended for the first 24 hours of curing time after the completion of concrete placing.

If the hydro demolishing scarification process is used, scarification may proceed during the final cleaning and overlay placement phases of the work on adjacent portions of the structure so long as the hydro demolisher operations are confined to areas which are a minimum of 100 feet away from the defined limits of the final cleaning or overlay placement in progress. If the hydro demolisher impedes or interferes in any way with the final cleaning or overlay placement as determined by the Engineer, the hydro demolishing work shall be terminated immediately and the hydro demolishing equipment removed sufficiently away from the area being prepared or overlaid to eliminate the conflict. If the grade is such that water and contaminates from the hydro demolishing operation will flow into the area being prepared or overlaid, the hydro demolishing operation shall be terminated and shall remain suspended for the first 24 hours of curing time after the completion of concrete placement.

I. If, after final cleaning, the lane or strip being overlaid becomes wet, the Contractor shall flush the surface with high pressure water, prior to placement of the overlay. All free standing water shall be removed prior to concrete placement. Concrete placement shall begin within 24 hours of the completion of deck preparation for the portion of the deck to be overlaid. If concrete placement has not begun within 24 hours, the lane or strip being overlaid shall be cleaned by a light sand blasting followed by washing with the high pressure water spray or by cleaning with the high pressure spray as approved by the Engineer.

J. Traffic other than required construction equipment will not be permitted on any portion of the lane or strip being overlaid that has undergone final preparation for placing concrete unless approved by the Engineer. To prevent contamination, all equipment allowed on the deck after final cleaning shall be equipped with drip guards.

4.02 Mixing Concrete

A. Mixing of concrete shall be in accordance with Section 6-02, with the following exceptions:

1. The mixing shall be done at a batch plant.

2. The volume of concrete transported by truck shall not exceed 4 cubic yards per truck.

4.03 Overlay Thickness

A. The overlay shall have a thickness of 1 1/2 inches. The thickness shall be verified prior to the placement of concrete by attaching a filler block, having a thickness of 1/4 inch less than the overlay thickness, to the bottom of the screed. The filler block shall pass freely over the surface to be overlayed. With the screed guides in place, the finishing machine shall be passed over the entire surface to be overlaid and the final screed rail adjustments shall be made.

B. If the overlay thickness does not verify, the profile of the new concrete surface shall be adjusted as approved by the Engineer.

C. After the overlay thickness has been verified, changes in the finishing machine elevation controls will not be allowed.

4.04 Installing And Removing Screed Rails

A. Rails upon which the finishing machine travels shall be placed outside of the area to be overlaid. Interlocking rail sections or other approved methods of providing rail continuity are required. Plans for anchoring rails shall be submitted in accordance with Section 1-05.3, to the Engineer for approval.

B. Hold-down devices shot into the concrete are not permitted unless the concrete is to be subsequently overlaid. Hold-down devices of other types leaving holes in the exposed area will be allowed provided the holes are subsequently filled with a sand/cement grout (sand and portland cement in equal proportions by volume). Hold-down devices shall not penetrate the existing deck by more than 3/4 inch.

C. Rails may be removed at any time after the concrete has taken an initial set. Adequate precautions shall be taken during the removal of the finishing machine and rails to protect the edges of the new surfaces.

D. The Contractor shall be responsible for setting screed control to obtain the nominal overlay thickness specified as well as the finished surface smoothness requirements.

4.05 Placing Concrete

A. Prior to concrete placement, the Contractor shall review the equipment, procedures, personnel and previous results with the Engineer. Inspection procedures shall also be reviewed to assure coordination.

B. Concrete placement shall be made in accordance with Section 6-02 and the following requirements:

1. After the lane or strip to be overlaid has been prepared and immediately before placing the concrete, it shall be thoroughly soaked and kept continuously wet with water for a minimum period of six (6) hours prior to placement of the concrete. All free standing water shall be removed prior to concrete placement. During concrete placement, the lane or strip shall be kept moist.

The concrete shall then be promptly and continuously delivered and deposited on the placement side of the finishing machine.

A slurry of microsilica concrete, excluding aggregate, shall be thoroughly brushed into the surface prior to the overlay placement. Care shall be exercised to ensure that the surface receives a thorough, even coating and that the rate of progress is limited so that the brushed concrete does not become dry before it is covered with additional concrete as required for the final grade. All aggregate which is segregated from the mix during the brushing operation shall be removed from the deck and disposed of by the Contractor.

The Contractor shall ensure that a sufficient number of trucks are used for concrete delivery to obtain a consistent and continuous delivery and placement of concrete throughout the pour.

When concrete is to be placed against the concrete in a previously placed transverse joint, lane, or strip, the previously placed concrete shall be sawed back 6 inches to straight and vertical edges and shall be sandblasted or waterblasted before new concrete is placed. The Engineer may decrease the 6 inch saw back requirement to 2 inches minimum, if a bulkhead was used during previous concrete placement and the concrete was hand vibrated along the bulkhead.

2. Concrete placement shall not begin if rain is expected. Adequate precautions shall be taken to protect freshly placed concrete in the event that rain begins during placement. Concrete that is damaged by rain shall be removed and replaced by the Contractor, at the Contractor's expense, and to the satisfaction of the Engineer.

3. Concrete shall not be placed when the temperature of the concrete surface is less than 45 F or greater than 75 F, when the combination of air temperature, relative humidity, fresh concrete temperature and wind velocity at the construction site produces an evaporation rate of 0.15 pounds per square foot of surface per hour as determined from Table 6-02.3(6) of the Standard Specifications, or when winds are in excess of 10 MPH. If the Contractor elects to work at night to meet this criteria, adequate lighting shall be provided at the Contractor's expense and as approved by the Engineer.

4. If concrete placement is stopped for a period of one half hour or more, the Contractor shall install a bulkhead transverse to the direction of placement at a position where the overlay can be finished full width up to the bulkhead. The bulkhead shall be full depth of the overlay and shall be installed to grade. The concrete shall be finished and cured in accordance with these specifications.

   Further placement is permitted only after a period of twelve hours unless a gap is left in the lane or strip. The gap shall be of sufficient width for the finishing machine to clear the transverse bulkhead installed where concrete placement was stopped. The previously poured concrete shall be sawed back from the bulkhead, to a point designated by the Engineer, to straight and vertical edges and shall be sandblasted or waterblasted before new concrete is placed.

5. Concrete shall not be placed against the edge of an adjacent lane or strip that is less than 36 hours old.

4.06 Finishing Concrete

A. Finishing shall be accomplished in accordance with the applicable portions of Section 6-02.3(10) and This Special Provision. Concrete shall be placed and struck-off approximately 1/2 inch above final grade and then consolidated and finished to final grade with a single pass (the Engineer may require additional passes) of the finishing machine. Hand finishing may be necessary to close up or seal off the surface. The final product shall be a dense uniform surface. A light fog spray of water is permitted if required for finishing, as determined by the Engineer.

B. As the finishing machine progresses along the pour, the surface shall be given a final finish by texturing with a comb perpendicular to the centerline of the bridge. The texture shall be applied immediately behind the finishing machine. The comb shall consist of a single row of metal tines capable of producing 1/8 inch wide striations approximately 0.015 foot in depth at approximately 1/2 inch spacing. The combs may be operated manually or mechanically, either singly or in gangs (several combs placed end to end). This operation shall be done in a manner that will minimize the displacement of the aggregate particles. The texture shall not extend into areas within 2 feet of the curb line. The non-textured concrete within 2 feet of the curb line shall be hand finished with a steel or magnesium trowel.

C. Screed rails and construction dams shall be separated from the newly placed concrete by passing a pointing trowel along the inside surfaces of the rails or dams. Care shall be exercised to ensure that this trowel cut is made for the entire depth and length of rails or dams after the concrete has stiffened sufficiently that it does not flow back.

D. After the burlap cover has been removed and the concrete surface has dried, but before opening to traffic, all joints and visible cracks shall be filled and sealed with a high molecular weight methacrylate resin (HMWM). Cracks 1/16 inch and greater in width shall receive two application of HMWM. Immediately following the application of HMWM the wetted surface shall be coated with sand for abrasive finish.

4.07 Curing Concrete

A. As the texturing portion of the finishing operation progresses, the concrete shall be immediately covered with a single layer of clean, new or used wet burlap. The burlap shall meet the requirements of Section 9-23.5 and shall have a maximum width of 6 feet. The Engineer will determine the suitability of the burlap for reuse, based on the cleanliness and absorption ability of the burlap. Care shall be exercised to ensure that the burlap is well drained and laid flat with no wrinkles on the deck surface. Adjacent strips of burlap shall have a minimum overlap of 6 inches. Once in place, the burlap shall be lightly fog sprayed with water. A separate layer of white, reflective type polyethylene sheeting shall immediately be placed over the wet burlap. The concrete shall then be wet cured by keeping the burlap wet for a minimum of 42 hours after which the polyethylene sheeting and burlap may be removed.

B. Traffic shall not be permitted on the finished concrete until the specified curing time is satisfied and until the concrete has reached a minimum compressive strength of 3000 psi as verified by rebound number determined in accordance with ASTM C 805.

4.08 Checking for Bond

A. After the requirements for curing have been met, the entire overlaid surface shall be sounded by the Contractor, in a manner approved by and in the presence of the Engineer, to ensure total bond of the concrete to the bridge deck. Concrete in unbonded areas shall be removed and replaced with microsilica modified concrete by the Contractor, at the Contractor's expense. All cracks, except those that are significant enough to require removal, shall be thoroughly filled and sealed as specified in section 4.06D of this Special Provision.

B. After the curing requirements have been met, the Contractor may use compressed air to accelerate drying of the deck surface, crack identification, and sealing.